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(54) CYCLONE DUST COLLECTING DEVICE FOR VACUUM CLEANER

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(57) **ABSTRACT**

A cyclone dust collecting device using a corona discharge is provided. The cyclone dust collecting device includes a cyclone chamber rotating air drawn in from the outside to separate contaminants from the air, a discharge pipe guiding the air separated from the contaminants to the outside of the cyclone chamber and including a discharge electrode part with at least a part made of a conductive material and a power supply unit supplying a power to the discharge electrode part for the discharge electrode part to perform a corona discharge.

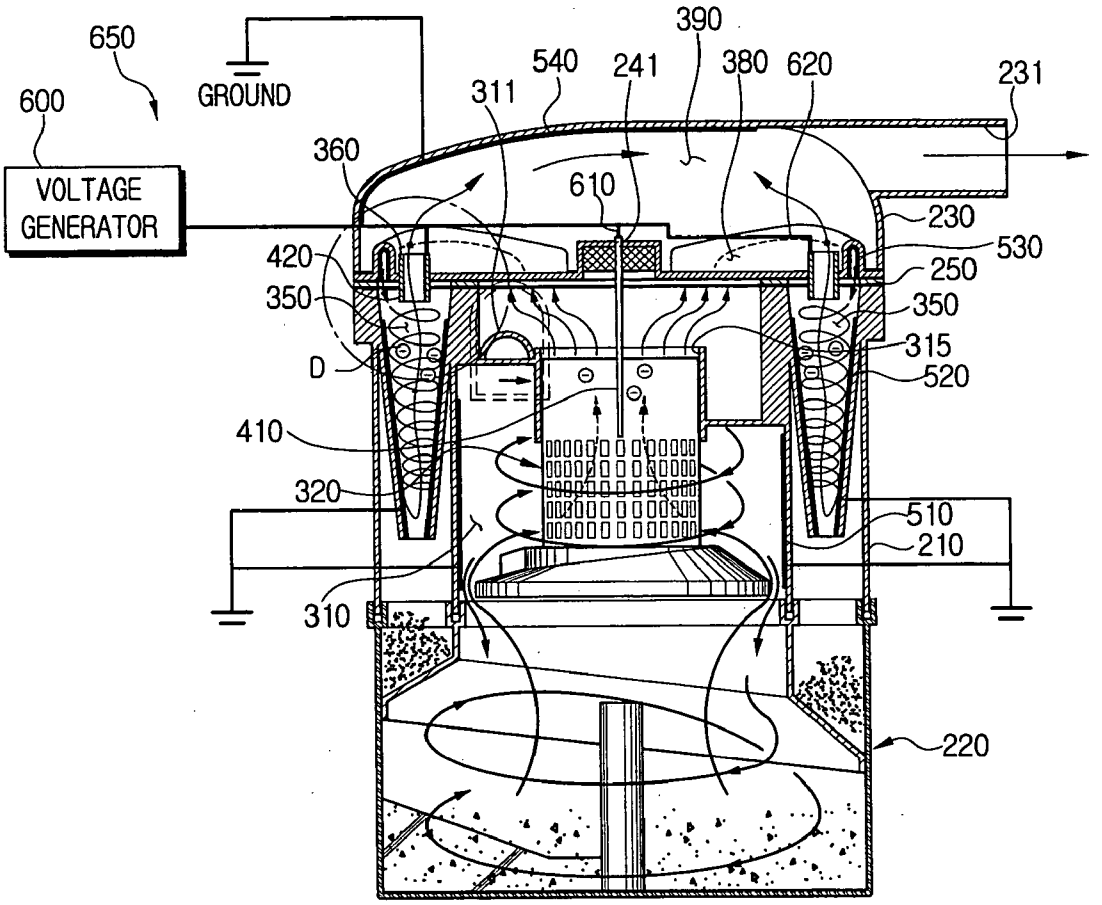


FIG. 1

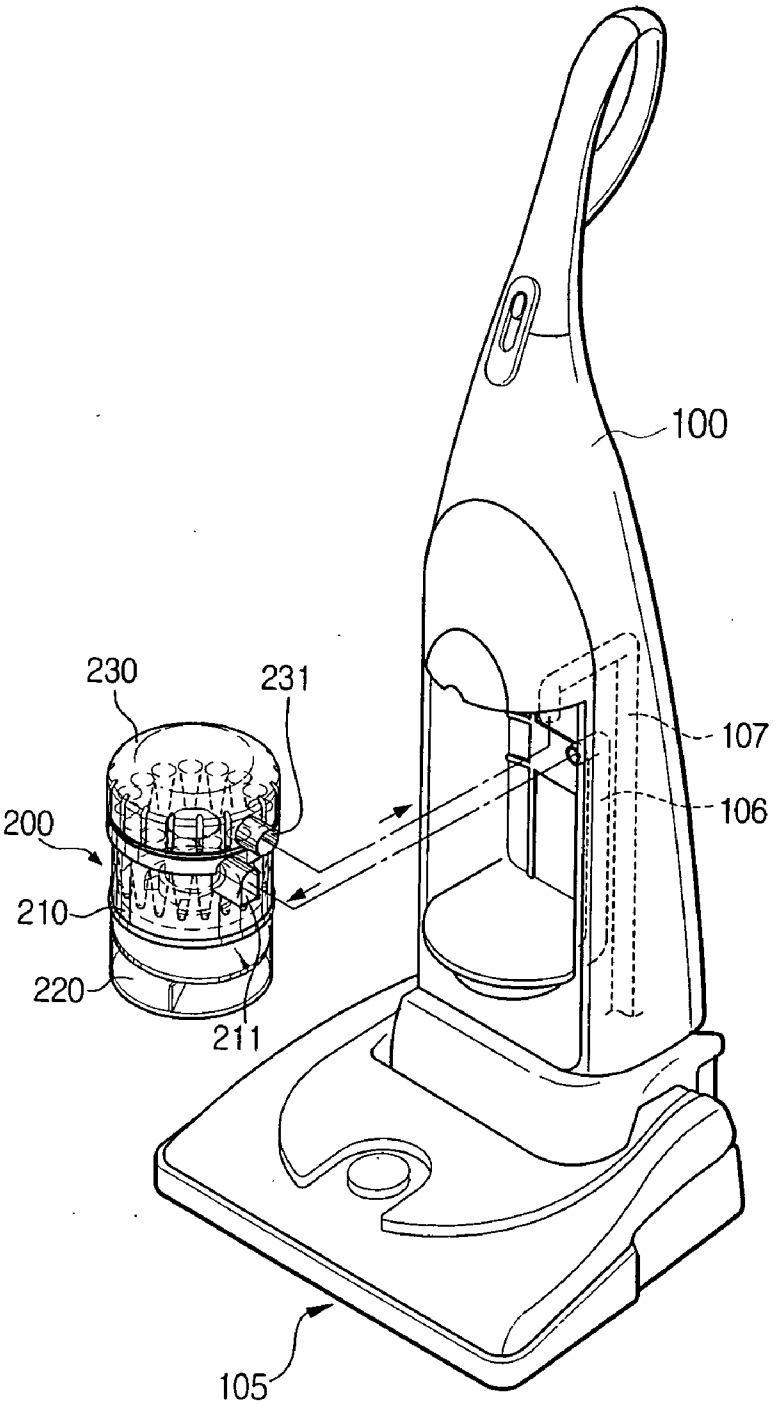


FIG. 2

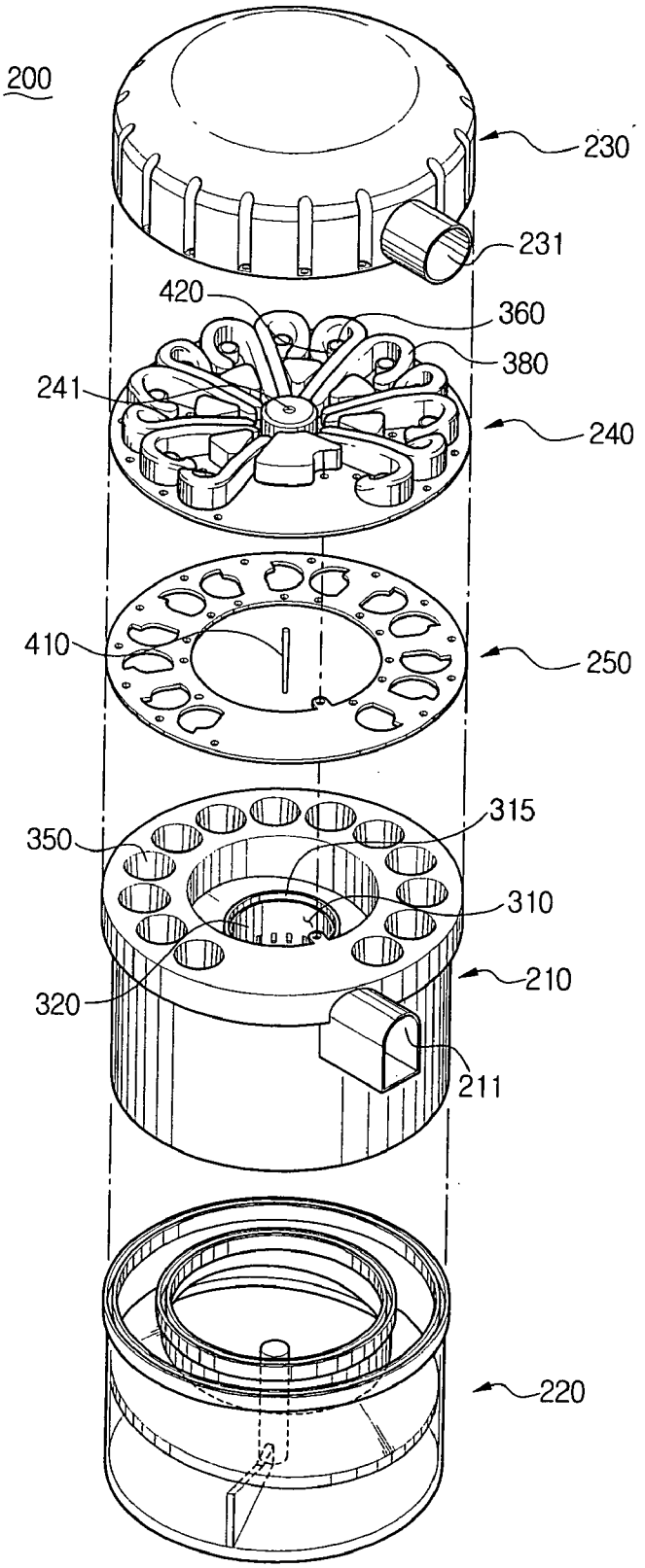

200
230
231
420
360
380
241
240
410
250
315
350
310
210
320
211
220

FIG. 3

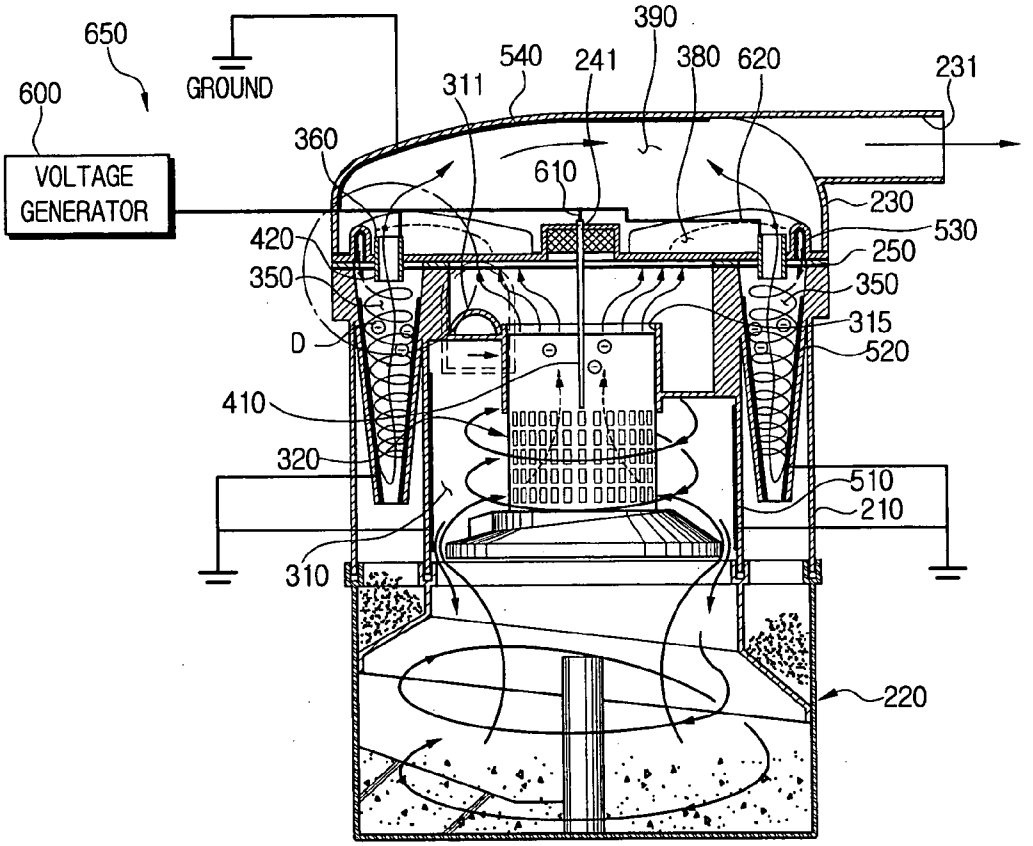

650
600
VOLTAGE GENERATOR
GROUND
311
540
241
390
380
620
231
360
610
230
530
420
250
350
350
315
D
520
410
320
510
210
310
220

FIG. 4

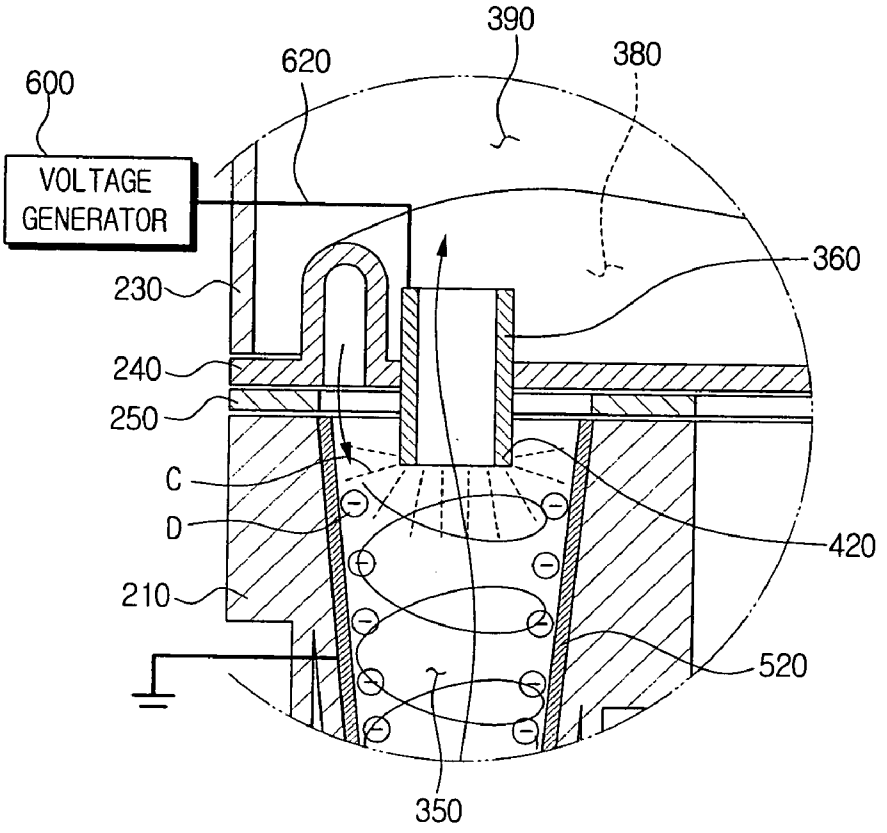

390
620
380
600
VOLTAGE GENERATOR
360
230
240
250
C
D
420
210
520
350

FIG. 5

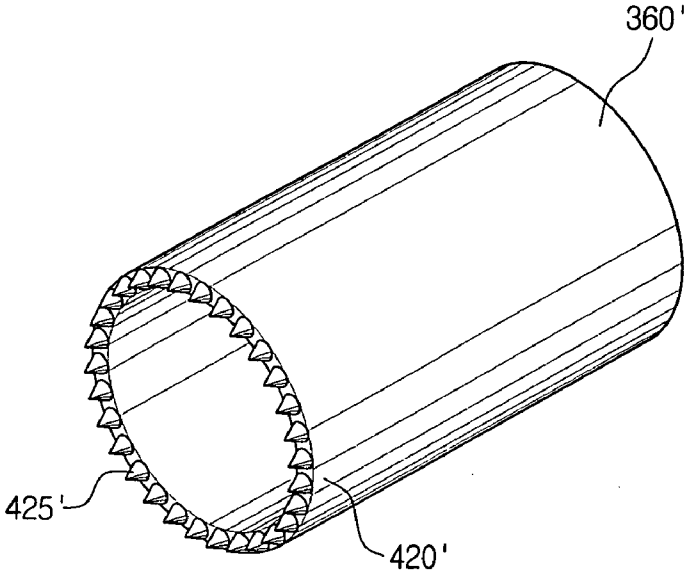

360'
425'
420'

FIG. 6

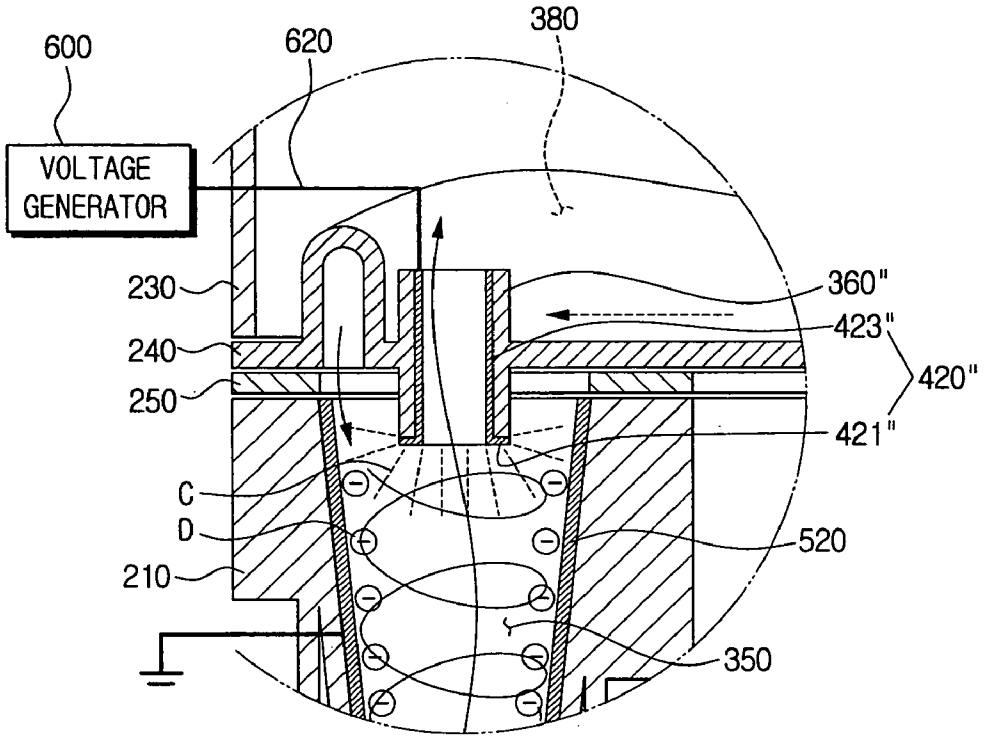
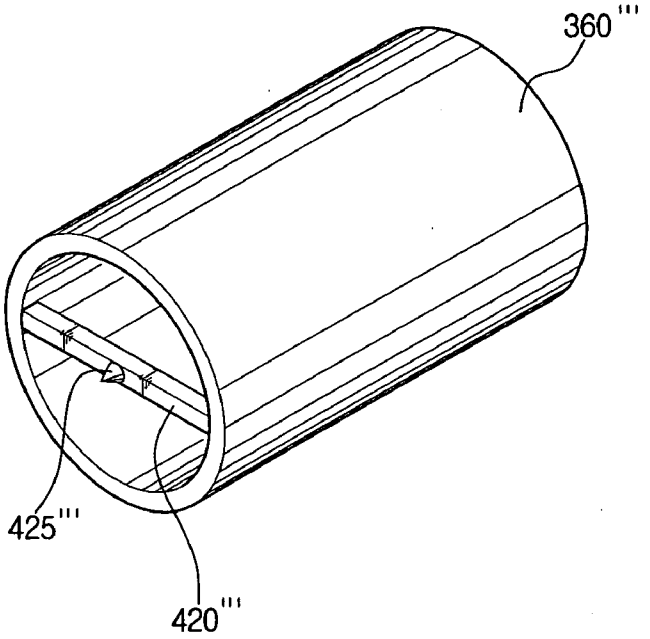

600
620
380
VOLTAGE GENERATOR
230
240
250
360"
423"
420"
421"
C
D
210
520
350

FIG. 7


360'''
425'''
420'''

CYCLONE DUST COLLECTING DEVICE FOR VACUUM CLEANER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit under 35 U.S.C. § 119 (a) of Korean Patent Application No. 2005-50897 filed on Jun. 14, 2005, the entire content of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a vacuum cleaner. More particularly, the present invention relates to a cyclone dust collecting device for a vacuum cleaner, which separates contaminant from drawn-in air by using a cyclone dust collecting system.

[0004] 2. Description of the Related Art

[0005] When a suction motor is driven, a vacuum cleaner draws in contaminant-laden air via a suction assembly from a surface and separates contaminants from the drawn-in air so as to clean the surface. To separate the contaminants, a dust collecting device is employed. Recently, a cyclone dust collecting device has been popularized which separates contaminants from drawn-in air by using a centrifugal force generated by rotating the drawn-in air.

[0006] The conventional cyclone dust collecting device is more convenient to use and more sanitary when compared to a dust bag; however, it has a poor separation efficiency of fine contaminants in the drawn-in air. To solve this problem, a cyclone dust collecting device with an improved separation efficiency of fine contaminants has been developed by generating a corona discharge in a cyclone dust collecting device and ionizing fine contaminants so that the ionized fine contaminants are electromagnetically separated from the drawn-in air. The conventional cyclone dust collecting device using the corona discharge generally has a separate discharge electrode part of a needle shape in a cyclone chamber. However, the discharge electrode part may be damaged due to the movement of air and contaminant in the cyclone dust collecting device so that the durability of the vacuum cleaner decreases and safety of a user cannot be guaranteed. Additionally, the amount of electric charge varies in a radial direction or an axial direction around the discharge electrode part, which limits the fine contaminant collection efficiency.

SUMMARY OF THE INVENTION

[0007] The present invention has been conceived to solve the above-mentioned problems occurring in the prior art, and an object of the present invention is to provide a highly durable cyclone dust collecting device, which uses a corona discharge to improve separation efficiency of fine contaminants.

[0008] Another object of the present invention is to provide a cyclone dust collecting device, which regularly distributes an average amount of electric charge around a discharge electrode so as to increase the dust collection efficiency.

[0009] In order to achieve the above objects, there is provided a cyclone dust collecting device including a cyclone body rotating drawn-in air from outside the cyclone body and separating contaminants from the air, a discharge pipe guiding the air separated from the contaminants to the outside of the cyclone body and including a discharge electrode part with at least a part made of a conductive material, and a power supply unit supplying a power to the discharge electrode part for the discharge electrode part to generate a corona discharge. Accordingly, due to the stable discharge electrode part, the durability increases and the average amount of electric charge is regularly distributed so that the fine contaminant separation efficiency increases.

[0010] The discharge pipe may be entirely made of a conductive material so as to form the discharge electrode part. The discharge pipe further includes at least one discharge protrusion integrally formed with the discharge electrode part, and the at least one discharge protrusion may be configured as a cone with a sharp end.

[0011] The discharge electrode part may include a discharge part and a connection part, and the connection part may be connected with the power supply unit to receive the power. The connection part may be configured as a pipe to enclose an inner surface of the discharge pipe. The discharge part may be integrally formed with the connection part.

[0012] The discharge electrode part may have opposite ends connected with the inner surface of the discharge pipe to go through an inside of the discharge pipe and include at least one discharge protrusion. The discharge electrode part may be configured as a beam.

[0013] The cyclone dust collecting device may further include a fine contaminant collection part made of a conductive material and formed on an inner surface of the cyclone chamber to collect a fine contaminant ionized by the corona discharge. The fine contaminant collection part may include a conductive paint sprayed on an inner surface of the cyclone chamber.

[0014] The cyclone dust collecting device may include a cyclone body having a first cyclone chamber at a central portion and at least one second cyclone chamber enclosing an outside of the first cyclone chamber, a contaminant receptacle detachably engaged with a bottom end of the cyclone body to receive the contaminant discharged from the cyclone chambers, a connection path guiding the air discharged from the first cyclone chamber into the at least one second cyclone chamber, and a cover part covering an opened top end of the cyclone body to form a discharge path guiding the air discharged from the at least one second cyclone chambers to an outside of the cyclone body. The discharge electrode part may be disposed in the second cyclone chamber.

[0015] The fine contaminant collection part may be formed over inner surfaces of the second cyclone chamber and the cover part.

[0016] The device may further include a discharge opening guiding the air discharged from the first cyclone chamber to the connection path, and a discharge needle having a top end connected with the power supply unit and a bottom end penetrating the discharge opening and disposed in the first cyclone chamber.

[0017] The device may further include a grille assembly disposed at the discharge opening to enclose the discharge needle. The fine contaminant collection part is also formed on inner surfaces of the connection path and the first cyclone chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above and other aspects, features and advantages of the present invention will become more apparent and more readily appreciated from the following detailed description of the embodiment taken with reference to the accompanying drawings of which:

[0019] **FIG. 1** is a view of a vacuum cleaner employing a cyclone dust collecting device according to an embodiment of the present invention;

[0020] **FIG. 2** is an exploded perspective view of a cyclone dust collecting device according to an embodiment of the present invention;

[0021] **FIG. 3** is a view of an example of a cyclone dust collecting device according to the first embodiment of the present invention;

[0022] **FIG. 4** is a view of an example of an important portion of the cyclone dust collecting device according to the first embodiment of the present invention;

[0023] **FIG. 5** is a perspective view of a discharge pipe according to the second embodiment of the present invention;

[0024] **FIG. 6** is a view of an example of an important portion of the cyclone dust collecting device according to the third embodiment of the present invention; and

[0025] **FIG. 7** is a perspective view of a discharge pipe according to the fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0026] Exemplary embodiments of the present invention will be described in detail with reference to the annexed drawings. In the drawings, the same elements are denoted by the same reference numerals throughout. In the following description, detailed descriptions of known functions and configurations incorporated herein have been omitted for conciseness and clarity.

[0027] Referring to **FIGS. 1 and 2**, a dust collecting device **200** according to the first embodiment of the present invention is mounted into a cleaner body **100** to connect with an air suction duct **106** and an air discharge duct **107**. As air is drawn in via a suction assembly **105**, the air flows first through the air suction duct **106** and then through an air inlet pipe **211**, and into the cyclone dust collecting device **200**. The cyclone dust collecting device **200** separates contaminants from the air and discharges the air from an air outlet **231** to the air discharge duct **107** and to the outside of the cleaner body **100**.

[0028] The cyclone dust collecting device **200** comprises a cyclone body **210**, a contaminant receptacle **220**, a cover part **230**, and an intermediate cover **240**. A gasket **250** is disposed between the intermediate cover **240** and the cyclone body **210** to prevent a leakage of air.

[0029] Referring to **FIGS. 2 and 3**, the cyclone body **210** according to the first embodiment of the present invention comprises a first cyclone chamber **310** and a plurality of second cyclone chambers **350**. The first cyclone chamber **310** is formed in a central portion of the cyclone body **210** with opened top and bottom portions. The first cyclone chamber **310** is connected with the air inlet pipe **211** and a central air discharge opening **315**. The air inlet pipe **211** penetrates a side of the cyclone body **210**. The air flows in via the air inlet pipe **211** into the first cyclone chamber **310**, where the air is rotated so that contaminants are separated by inertia. The air removed of contaminants flows via a grille member **320**, the central discharge opening **315** and connection paths **380** into the second cyclone chambers **350**. The plurality of the second cyclone chambers **350** are penetratingly formed in the cyclone body **210** to enclose the outside of the first cyclone chamber **310**. Top portions of the second cyclone chambers **350** are connected with discharge pipes **360** and the connection paths **380** formed at the intermediate cover **240**. Therefore, the air flowing via the connection paths **380** into the second cyclone chambers **350** is rotated in the second cyclone chambers **350**. While rotating, the air is separated from fine contaminants and then discharged via the discharge pipes **360**, a discharge path **390** and the air outlet **231** to the outside of the cyclone dust collecting device **200**.

[0030] The cyclone dust collecting device **200** according to the first embodiment of the present invention comprises a discharge needle **410**, a discharge electrode part **420**, a first, second, third, and fourth fine contaminant collection part **510**, **520**, **530**, and **540**, respectively, and a power supply unit **650** to increase the separation efficiency of fine contaminants by using a corona discharge. The power supply unit **650** comprise a voltage generator **600** generating a high voltage and a first and a second conductive wire **610**, **620** connecting the voltage generator **600** with the discharge needle **410** and the discharge electrode part **420**, respectively.

[0031] The voltage generator **600** is installed in the cleaner body **100** (refer to **FIG. 1**) to generate power to be supplied to both the discharge needle **410** and the discharge electrode part **420** by using the power applied to the cleaner body **100**.

[0032] The discharge needle **410** and the discharge electrode part **420** generate a corona discharge in the first and the second cyclone chambers **310**, **350** so that fine contaminants included in the air of the first and the second cyclone chambers **310**, **350** are ionized to have a negative (−) electric charge. The discharge needle **410** is provided in the first cyclone chamber **310** such that the top end thereof penetrates a penetrating opening **241** (refer to **FIG. 2**) of the intermediate cover **240** to be exposed to the discharge path **390** and the bottom end thereof penetrates the central air discharge opening **315** to be disposed in the grille member **320**. The top end of the discharge needle **410** exposed to the discharge path **390** is connected via the first conductive wire **610** with the voltage generator **600** so as to receive the power for the corona discharge. The discharge electrode part **420** is provided in the second cyclone chambers **350**. As shown in **FIGS. 3 and 4**, the discharge pipes **360** guiding the air discharged from the second cyclone chambers **350**, are made of conductive material so that terminal ends of the discharge pipes **360** disposed in the second cyclone chambers **350** perform functions of the discharge electrode part

420. Accordingly, the top ends of the discharge pipes **360** are connected via the second conductive wire **620** with the voltage generator **600** to transmit power to the discharge electrode part **420**. Accordingly, the average amount of electric charge is regularly distributed so that the dust collection efficiency increases and stable operation can be guaranteed under a fast flow speed.

[**0033**] The first and the second fine contaminant collection parts **510**, **520** are formed in a grounded condition on inner surfaces of the first and the second cyclone chambers **310**, **350**. The third and the fourth fine contaminant collection parts **530**, **540** are formed in a grounded condition on inner surfaces of the connection paths **380** and the cover part **230**. Accordingly, after being ionized by the discharge needle **410**, fine contaminants D are collected by the first and the third fine contaminant collection parts **510**, **530** while flowing toward the second cyclone chambers **350**. The fine contamiants D that are not collected by the first and the third fine contaminant collection parts **510**, **530** flow into the second cyclone chambers **350**, are re-ionized by the discharge electrode part **420** and then collected by the second and the fourth fine contaminant collection parts **520**, **540**. The fine contaminant collection parts **510**, **520**, **530**, **540** can collect the fine contaminants D by using the electromagnetic force only if the fine contaminant collection parts are made of conductive material and rightly grounded. The fine contaminant collection parts **510**, **520**, **530**, **540** according to the present embodiment are formed by spraying a conductive paint over the first cyclone chamber **310**, the second cyclone chambers **350**, the intermediate cover **240** forming the connection paths **380**, and the cover part **230** forming the discharge path **390**. Therefore, the fine contaminant collection parts **510**, **520**, **530**, **540** do not require the cyclone dust collecting device **200** to have a complicated structure. However, a member of conductive material may be separately formed.

[**0034**] The method for separating fine contaminants by using the discharge needle **410**, the discharge electrode part **420** and the fine contaminant collection parts **510** through **540** will be explained with reference to **FIG. 4**. As the air flows via the connection paths **380** into the second cyclone chambers **350**, the air is rotated in the second cyclone chambers **350** to separate the contaminants by centrifugal force. Around the discharge electrode part **420**, a corona discharge C is generated by the power applied from the voltage generator **600** to the discharge electrode part **420**. Due to the corona discharge C, the fine contaminants D included in the air are negatively (−) ionized. As the fine dusts D are negatively ionized as described above, the grounded second fine contaminant collection part **520** formed on the inner surface of the second cyclone chambers **350** performs the same effect as being positively (+) charged so as to attract negatively ionized fine contaminants D. Therefore, the negatively ionized fine contaminants D are not discharged via the discharge pipes **360** to the outside of the second cyclone chambers **350** but collected on the second fine contaminant collection part **520** sprayed on the inner surface of the second cyclone chambers **350**. Ionized fine contaminants D that are discharged via the discharge pipes **360** to the outside of the second cyclone chambers **350** without being collected on the inner surface of the second cyclone chambers **350**, are collected on the fourth fine contaminant collection part **540** of the inner surface of the cover part **230** as shown in **FIG. 3** so as to be prevented from being discharged to the outside of the cyclone dust collecting device **200**. Therefore, the cyclone dust collecting device **200** has an increased separation efficiency of fine contaminants.

[**0035**] The discharge electrode part **420** can be implemented by various configurations. In case of the discharge needle **410**, the needled-shaped configuration may be most preferable as shown in **FIG. 3** because a part of the discharge needle **410** is disposed in the grille member **320**. However, there is no limit to the configuration of the discharge electrode part **420** if the discharge electrode part **420** can be firmly supported by the discharge pipes **360**. For example, the discharge electrode part **420** may be integrally formed with the discharge pipes **360**.

[**0036**] **FIG. 5** is a view of a discharge electrode part **420'** according to the second embodiment of the present invention. The discharge electrode part **420'** is the same as the discharge electrode part **420** according to the first embodiment of the present invention in that an entire discharge pipe **360'** is made of a conductive material. However, the discharge electrode part **420'** can be distinguished from the discharge electrode part **420** according to the first embodiment of the present invention in that the discharge electrode part **420'** includes one or more discharge protrusions **425'**, which are integrally formed with the discharge electrode part **420'** to protrude toward the inside of the second cyclone chambers **350** (refer to **FIG. 4**). The discharge protrusions **425'** are formed because the corona discharge can be more easily performed at a sharp portion. The discharge protrusions **425'** may be formed in various configurations. However, to easily perform the corona discharge, it is preferable to form the discharge protrusions **425'** with a sharp end and sides tapering to a point.

[**0037**] **FIG. 6** is a view of an example of a discharge electrode part **420"** according to the third embodiment of the present invention. Referring to **FIG. 6**, the discharge electrode part **420"** in the present embodiment comprises a connection part **423"** inserted in discharge pipes **360"** and a discharge part **421"** exposed to a bottom end of the discharge pipes **360"**. The connection part **423"** is configured as a pipe to enclose the inner surface of the discharge pipes **360"**. Therefore, although the intermediate cover **240** is made of synthetic resin material, the discharge electrode part **420"** can be easily formed. In the present embodiment as the aforementioned second embodiment, a plurality of discharge protrusions **425'** (refer to **FIG. 5**) may be protrusively formed integrally with the discharge electrode part **420"**. In this case, the corona discharge can be more effectively performed.

[**0038**] **FIG. 7** is a view of a discharge electrode part **420'"** according to the fourth embodiment of the present invention. Referring to **FIG. 7**, the discharge electrode part **420'"** is made of a conductive material and configured as a beam. Opposite ends of the discharge electrode part **420'"** are connected with the inner surface of the discharge pipes **360'"** so as to go across the inside of the discharge pipes **360'"**. The discharge electrode part **420'"** and the discharge pipes **360'"** may be made of the same material and integrally formed with each other. The discharge electrode part **420'"** according to the present embodiment has a conical discharge protrusion **425'"** protruding from the central portion. The operation of the discharge protrusion **425'"** is the same as

that of the discharge protrusions **425** of the second embodiment, and therefore, the detailed description thereof will be omitted.

[0039] The embodiments of the present invention has been explained by using an example in which a cyclone dust collecting device employing a plurality of cyclone chambers has a discharge electrode part. However, this should not be considered as limiting. The embodiments of the present invention may be applied to a cyclone dust collecting device employing a single cyclone chamber.

[0040] If the embodiments of the present invention are applied, the discharge electrode part can be easily formed, and more stably formed onto the discharge pipe. Therefore, even though air and/or contaminants are flowing in the cyclone chamber, damage to the discharge electrode part can be prevented.

[0041] The average amount of electric charge around the discharge electrode part is regularly distributed so that the collection efficiency of fine contaminants is increased.

[0042] Additional advantages, objects, and features of the embodiments of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following, or may be learned from practice of the invention. The objects and advantages of the embodiments of the invention may be realized and attained as particularly pointed out in the appended claims.

What is claimed is:

1. A cyclone dust collecting device comprising:

a cyclone body rotating drawn-in air from an outside of the cyclone body to separate contaminants from the drawn-in air;

a discharge pipe guiding the drawn-in air separated from the contaminants to the outside of the cyclone body and including a discharge electrode part with at least a part made of a conductive material; and

a power supply unit supplying a power to the discharge electrode part,

wherein the discharge electrode part generates a corona discharge.

2. The device according to claim 1, wherein the discharge pipe is entirely made of the conductive material so as to form the discharge electrode part.

3. The device according to claim 1, further comprising at least one discharge protrusion integrally formed with the discharge electrode part.

4. The device according to claim 3, wherein the at least one discharge protrusion is configured as a cone with a sharp end.

5. The device according to claim 1, wherein the discharge electrode part includes a discharge part and a connection part, the connection part being connected with the power supply unit to receive the power.

6. The device according to claim 5, wherein the connection part is configured as a pipe to enclose an inner surface of the discharge pipe.

7. The device according to claim 5, wherein the discharge part is integrally formed with the connection part.

8. The device according to claim 1, wherein the discharge electrode part has opposite ends connected with an inner surface of the discharge pipe to go across an inside of the discharge pipe and includes at least one discharge protrusion.

9. The device according to claim 8, wherein the discharge electrode part is configured as a beam.

10. The device according to claim 1, further comprising:

a fine contaminant collection part made of a conductive material and formed on an inner surface of the cyclone body to collect fine contaminants, the fine contaminants being ionized by the corona discharge.

11. The device according to claim 10, wherein the fine contaminant collection part comprises a conductive paint sprayed on an inner surface of the cyclone body.

12. The device according to claim 10, wherein the cyclone body comprises:

a first cyclone chamber at a central portion of the cyclone body and at least one second cyclone chamber enclosing an outside of the first cyclone chamber;

a contaminant receptacle detachably engaged with a bottom end of the cyclone body to receive the contaminants discharged from the cyclone chambers;

a connection path guiding the drawn-in air discharged from the first cyclone chamber into the at least one second cyclone chamber; and

a cover part covering an opened top end of the cyclone body to form a discharge path guiding the drawn-in air discharged from the at least one second cyclone chamber to an outside of the cyclone body,

wherein the discharge electrode part is disposed in the at least one second cyclone chamber.

13. The device according to claim 12, wherein the fine contaminant collection part is formed over inner surfaces of the at least one second cyclone chamber and the cover part.

14. The device according to claim 13, further comprising:

a central air discharge opening guiding the drawn-in air discharged from the first cyclone chamber to the connection path; and

a discharge needle having a top end connected with the power supply unit and a bottom end penetrating the central air discharge opening and disposed in the first cyclone chamber.

15. The device according to claim 14, further comprising:

a grille assembly disposed at the central air discharge opening to enclose the discharge needle; and

a second fine contaminant collection part formed on an inner surface of the connection path.

16. The device according to claim 12, further comprising a second fine contaminant collection part formed on an inner surface of the first cyclone chamber.

* * * * *